Speaker 1: Bulletproof Radio, a state of high performance.

Dave: You're listening to Bulletproof Radio with Dave Asprey. Today's cool fact of the day is that if it takes you a while to recover from a few lost hours of sleep, be glad you're not an Orb-weaver spider. They have the shortest natural circadian rhythm discovered in any animal so far. Most of us have body clocks that run closer to a 24-hour day-night cycle, and light helps you to reset that.

But the Orb-weaver's body clock runs on an 18-hour cycle, which means that these little spiders have to shift their cycle of activity and inactivity by about five hours everyday just to keep up with the normal solar cycle. Be glad you're not a spider.

Today's podcast is the second half of the interview with Satchin Panda. In the first half, we talk a lot about circadian lighting and things like that. Today, we're going to talk more about meal timing. And it turns out that both food and light have a profound effect on what your body does, how its timing signal works. You learn a lot of really crazy stuff actually about the fact that when you eat changes everything. And I was just blown away by this interview. I think you will be too.

Satchin: When it comes to that, as you pointed out, just taking care of light exposure or less light during night-time, or more light during the daytime is really key to keeping our brain circadian clock functional. Similarly, almost nine years ago, we made another big discovery. That is, we know that almost every organ in our body has a circadian clock.

That means, just like our brain has a clock that makes us to sleep, similarly our liver, gut, every organ, even our skin, even our hair follicle, everything has clocks. And what we found is, it's not that light, that resets the rest of the clock outside the brain, but it's went we eat.

Dave: Yes.

Satchin: If we take mice, which essentially are naturally prone to eating only at night-time, and if we give them food only during daytime, we can reset all of their clocks to the daytime cycle. That made us really curious about what happens when people eat randomly throughout day and night, because just like the first ray of light in the morning tells our brain that the day has just started, and get ready for the day, similarly, the first bite of the day tells our gut, our liver, and our muscle, and our fat cells that the day has just started and start doing your job.

At the same time, if we continue eating late into the night, then all these clocks get confused. And they don't know whether it's day or night. Just like I said, the incompatible processes will start working together. That means, it's almost like texting and driving from Boston to New York, or Seattle to Vancouver. You can go a few miles, but then after a few miles, you're chance of getting into an accident goes up. That's what happens, we think.

To test this very simple idea that, forget about calories, forget about what kind of food you eat, if we control timing, how much of benefit you can get? So we went back to a mouse room, and we repeated an experiment that has been done 10,000 times in many different academic labs, drug industry, and many places. There are 10,000 papers on it.

And that's, if you give mouse a high-fat diet, they're ready to eat anytime. When I say high-fat, it's around 60%, 40 to 60% of calories come from fat, and then 20% calories come from pure sucrose, then they become morbidly obese very quickly, within 9 to 10 weeks, they're overweight. And by 15, 16 weeks, they're obese, morbidly obese.

We brought two groups of mice. One group got free access to high-fat, high-sucrose diet. They can eat whenever they want. And then, the other group got the same number of calories from the same high-fat, high-sucrose diet, but they had to eat all their food within eight to nine hours at night-time when their circadian clock tells them to eat.

Surprisingly, after 16 weeks or 18 weeks, these mice that were eating the same [inaudible 00:04:37] within eight to nine hours, were completely healthy. They were not overweight, they were not obese, they had completely normal liver function, normal cholesterol, normal glucose control. They actually stayed on treadmill twice longer than mice that ate normal standard diet.

Dave: On the same food?

Satchin: The same food. And in fact, if we take the mice that are already obese and overweight, if we give them the same food, but they have to eat only within eight hours, we can reverse their disease. And that was so earth-shattering, that I could not believe it. I had to ask three different people in my lab, to independently run this. And even I personally went and repeated this to make sure that this is true, because this is against anything that we know.

We have repeated that experiment, and now a lot of different labs from all over the world have repeated, and they find the same finding, that the timing has a huge impact. It doesn't mean that we should continue to eat bad food. It just shows that the timing has a huge impact.

Dave: What did this do for your mom?

Satchin: For my mom, you said?

Dave: Yeah.

Satchin: Oh, yeah. I'll go to that story. What happened was we saw this result in mouse, and we kept applying for federal grant money to learn this more, and to figure out why, what is the mechanism etc? And our reviewers and many people in nutrition field, they said that, "Well, we humans, we all eat three meals a day within 12 hours, so your research has no significance." And that was really depressing.

But at the same time, we asked, "Well, has anybody figured out when people actually eat?" Because we always think that we eat within 12 hours. But when I looked at myself at that time, I realized that I start my day very early. I have a cup of coffee with cream and sugar around 7, 7:15. And I used to get home late. And then, at late at night, if I was working on a assignment or something, or a paper, then I would stay awake, and sip coffee and some cookies late into the night. I realized my eating window was around 16 hours. And I was overweight on that.

Dave: Like a mouse?

Satchin: Yeah. Like a mouse. Then we developed a very simple [inaudible 00:07:03]. Now it is called My Circadian Clock. And we asked people to just take a picture of their food, because with that simple picture we got what, when and how much? And if it [inaudible 00:07:14] they ate that food. They just had to take a picture and we did the rest.

And in the first study, we had 156 healthy adults. All of them claim that they eat all their food within 12 hours. And when we asked them to log everything honestly for three weeks, what we found is nearly 50% of those healthy cohorts, healthy adults were eating their food over 15 hours or longer.

And when we showed them their data, then they were surprised, they said, it's almost like you feel like you're healthy and hansom until you stand in front of a mirror, and then you realize, oh, well, I got to take care of my hair, or I haven't shaved for a couple of days, and all that stuff. It's almost like that. Logging your own data honestly for two to three weeks, and looking at it was a huge surprise for half of these people.

Then, the second thing that we did was, well, these people are healthy, but not necessarily within healthy weight. Some of them were overweight and obese. We asked some of them to see whether they can eat whatever they want, how much ever they want within a self-selected 10-hours window. Because in mice, by that time, we had done many experiments and we figured out that somewhere between 8 to 12 hours is a good point. And beyond 12 hours, eating everything beyond 12 hours is not that healthy.

And we thought if we ask people to eat everything within 10 hours, they might occasionally eat outside and it'll come around 10 and a half to 11. And surprisingly, everyone we had asked to participate in this study, they actually loved the study, and they stayed within 10 to 10 and a half hours for 16 weeks. Then we completely cut them off, no contact with them for a year. And we brought them back again. And without any further input, we are surprised that they stayed with that new habit.

And when we asked them, why did you stay with this new habit? They said, "Well, this is very easy to do, because there is no food deprivation. Whatever we wanted to eat." A lot of us actually don't have access to healthy food. A lot of us go to work and then there is only one or two restaurant or cafeteria or a vending machine. And whatever education we have about health and nutrition, we don't have access to, really. We cannot change their diet. They are happy that they stayed with that.

And second thing was, a lot of them, almost everybody said they slept better. And everybody said they felt more energetic, and they had less hunger. This is really interesting, because people would think that if you eat within 10 hours then you'll feel hungry. But conversely, they were more satisfied with their food. And of course, when we went back and looked at their ... They were also collecting pictures of their food at least for few weeks. Of course, when we kind of guesstimated all the calories and found that they unknowingly reduced their calorie intake by 10 to 20%.

We didn't have to tell them count calories and reduce calories. But what happened was when they stopped, when they ate everything within 10 hours, they cut out all the late night snacks and alcohol. And similarly, very early morning, some of them actually started their coffee a little bit later, so they cut out the early cookies that they was to eat with their coffee. So it was kind of interesting.

Dave: What about like black coffee or tea without sugar? Does that count?

Satchin: Well, so that's very interesting. We get this question of course from everybody. Of course, we cannot do that experiment in mouse. Mice don't like coffee. And in humans we are still waiting to get some funding to do that. But what I'll tell you is just entirely based on my guess and what I know, some educated guess.

When it comes to say, insulin response, of course, since we are not putting any sugar into coffee and there is no cream, we may not get a spike in insulin or glucose. In early morning, when you're trying to wake up and get to work and feel that extra boost of energy, that black coffee may be okay.

But at the same time, when I stand in line in Starbucks or Peet's Coffee, then I see almost 95% of people will get that coffee, come back to the milk and cream station, and then pour a lot of sugar and cream and drink their coffee. That's why we tell people, "No. Drinking coffee outside that window is not allowed, because we know 95% of people do this." But if some people can control and can have only black coffee, then at least this should be okay in the first half of the day.

But in the second half of the day, as you know, a lot of us take a long time to break down that caffeine, and if people want to sleep a little bit earlier or have a better sleep, then they should stop coffee I'd say after lunch. So that should be [inaudible 00:12:29].

Dave: Yeah. My standard recommendation is don't drink caffeine after 2 p.m. if you wanna sleep. It's just not a good plan.

Satchin: Yeah.

Dave: I find most people tolerate decaf after that, because the amounts are very low. I'll do decaf in the evening even, but I drink it black if I'm gonna do it in the evening, right.

Satchin: The nice thing is when you drink black, then you can actually get away with less coffee, because it's so strong, and that ...

Dave: That's just because you don't like it.

Satchin: No-no. I mean, you can still drink it, but the thing is, you're not taking that extra calories from sugar and cream.

Dave: Ah. Right. Now, one of the things that I became aware of is that insulin and blood sugar are part of the signal for circadian biology. And we also know that high insulin over time and high blood sugar levels cause other types of aging and degradation in the body. Part of the reason that I came up with the original Bulletproof Coffee, which has just grass-fed butter and Brain Octane that raises ketones in it, was that it has zero insulin effect.

And third parties have studied every common breakfast out there, and the one with the lowest possible, like zero insulin response was, well, if you just have that in the morning, you can get some energy in the system, because you get those ketones going, but you don't have the blood sugar stuff. Have you seen any research or any preliminary stuff around blood sugar versus blood ketones in circadian setting?

Satchin: Well, the blood sugar is very interesting. When people ask us, well, if they want to do time-restricted eating, we called it time-restricted eating, because timing is restricted, calorie is not restricted.

Dave: Right.

Satchin: When they should do it. Early morning or the first half of the day, [inaudible 00:14:12] start around eight or nine. Go till five or six. Or they can start around noon and go late into the night. And this is where circadian rhythm comes in. And this is where we still have to learn a lot, but this is a very exciting, every interesting area that we'll see a lot of progress. That is this.

If you take a healthy human and give a bolus of sugar in the morning, and measure blood, glucose and insulin, this healthy person will be diagnosed healthy. The blood sugar will rise for few minutes and will come back to normal within 90 minutes. Now, you take the same healthy person and give them the same bolus of sugar in the middle of the evening, say 8 or 9 p.m., then the blood sugar might rise pretty high to almost pre[inaudible 00:15:08] and then it will take very long time to come back.

That's a very clear circadian effect. And in fact, in '70s, doctors had a funny term for this. They used to call it the evening diabetes. That means, in the morning, the same person might be diagnosed healthy, and the evening, if you give a diabetes test, postprandial glucose test, then, the person might be diagnosed diabetes.

And what we are learning now is just I say, every organ has a circadian clock, our pancreas also has a circadian clock. And the pancreas clock essentially tells the pancreas the kitchen is closed after six o'clock, you don't have to produce too much insulin. Now, pancreas doesn't release enough insulin after an evening meal. Insulin kind of comes in small drips, not in a big flow, or rush as it happens in the morning.

So as the insulin comes in small drip for very long period of time, as we know, insulin is anabolic, so it'll help some of the sugar to be stored as fat. A late night meal might tell your body to store a big portion of it as fat instead of using it as glycosine or burning it [inaudible 00:16:24] right away.

Then another interesting thing, where light and insulin, they get together, is a few years ago large human genetic studies to look at diabetes found that melatonin receptor, this is a protein that binds to melatonin and signals the cell that, hey, melatonin is there, do your stuff. That melatonin receptor mutation appeared again and again in human subjects who were either diabetic or overweight. And that was confusing for a lot of people. That's why a lot of research went into it.

And now we know that the melatonin receptor is present in pancreas. And when it engages with melatonin, then it tells the pancreas not to secrete as much insulin. That might be the reason why at night-time as we naturally build up our melatonin level, we also tell our pancreas that this is night-time, the kitchen is closed, and you can go back to sleep. It's almost like a sleep signal to the pancreas. And at that time if we ate then we end up storing more in fat and also keeping our blood sugar high for long period of time.

Dave: Quite interesting. What about ketones? When people go in ketosis, and I always have background ketones, because of the way I eat. But I don't do a zero carb diet. Most of the time I cycle in an out. We're not tying the pancreas in at all, and there's many different pathways that are affected by ketones, but I'm unaware of circadian research tied into ketosis. But given that so many people are now doing things like Bulletproof Coffee, or keto diets and things like that, do you think that there's a role in setting circadian rhythm by manipulating fat versus sugar versus protein?

Satchin: What we have done is, it started with mice. As I told you, in mice, when we put these mice on eight hours or 10 hours eating window, and they go through somewhere between 14 to 16 hours of fasting, then those mice run on treadmill twice longer than mice that have a limited access to even healthy diet.

That triggered us to think what is going on here? And that advantage goes away if the mice eat for 12 hours. Everything else remains the same. They have the same body weight, they have the same blood sugar, and everything same. Only when they go to eight hours or 10 hours then we see this advantage in endurance.

And what we find is when mice eat for eight to 10 hours then towards the end of the fasting period they naturally build up their ketone bodies. That means, the ketone-making enzymes are the pathway that breaks down fat into ketone, those are activated by circadian rhythm, but it also requires the combination of having a good rhythm and that long fasting of more than 12 hours. And what is interesting is through our circadian, my circadian clock, a lot of athletes and a lot of health enthusiast have been following time-restricted eating ...

Dave: Oh, yeah.

Satchin: ... and they experiment themselves between 12 hours, 10 hours and eight hours. And a lot of them, they report us back, that when they do eight hours eating or 10 hours eating, then they can do that marathon less tired. Or some people who are just going for spinning classes, after an hour they're less tired. That is kind of telling us that the circadian program to make ketone bodies towards the end of our fasting cycle, and that ketone body has a huge impact not only on cardiovascular health but also on brain health.

And in fact, in follow-up to that basic science research that we did in mice, there was another study that came out from Europe that showed that, yes, when rats or mice are given access to food only for six hours, then they make ketone bodies and that ketone body goes to the brain and acts on certain parts, only on certain part of the brain, clock neurons to start what is called exploratory activity.

That means, when we're hungry ... Actually if you think about it, if you dial back, say 100 years or 200 years back, if it was a winter night, or even a long night, the person, our ancestors, they had their meal maybe around just before evening. And then, they fasted for the entire night, 12 hours. And then, after twilight [inaudible 00:21:21] maybe at 10 o'clock in the morning, they would go hunt. And they have gone through almost 14 to 16 hours of fasting.

But what is interesting is they have to, their brain has to act much better in that hungry state. And the muscles have to act much quicker in that hungry state to go and catch that deer or some other animals. That's why we are programed to go through this daily cycle of ketosis, so that in the last two to four hours of our fasting period, we build up that ketone body to make our brain more active, our muscles more active, our heart more active so that we can go and hunt.

And that exactly we see even in these mice and rats. They become more active towards the end of their fasting cycle, and they go look for food even an hour or two before they're supposed to get food, they will get up and then start looking around. I think this is a very primordial signature, primordial program in our circadian system ...

Dave: Wow.

Satchin: ... that we naturally make. Yeah.

Dave: You think the ketones are actually driving the exploratory behavior?

Satchin: Yeah. That's what this paper actually showed from Europe. That if they get ketone ... And they actually did a very interesting experiment. They put this ketone in a programmable mini pump and implanted those mini pumps inside these rodents, so that they can control what time they can release ketones. And that mimicked the natural exploratory activity that these rats had.

Dave: You're blowing my mind, because I think I understand all of the mechanisms of Bulletproof Coffee, because I've noticed big differences when I do this. But when people

sleep for eight hours, they're getting a fasting window, and they should have mild ketones. And we know that even a tablespoon of coconut oil raises ketones as much as eight hours of fasting. But the oil that's in Bulletproof Coffee, Brain Octane, raises ketones four times more.

I didn't realize that ketones drove exploratory behavior, because what I'm doing is I'm fasting for probably more like 10, 12 hours or something by the time I wake up. I'm already making some ketones. Then I do a Bulletproof Coffee, which raises my ketones substantially more, and then I feel like amazing. But what you're helping me understand here is that it may actually be driving my exploratory behavior, because I got the fasting ketones and then I dumped some more without a ketone pump, but I dump those in, but I'm not food-seeking, because I also changed ghrelin and CCK levels and things like that.

You completely just blew my mind there, because the exploratory behavior is something I didn't describe with that word, but I just feel like I wanna go do stuff, right. And it may be driven by ketones plus circadian biology, and I didn't get that circadian link until you just told me this, so thank you. Okay. Well, that totally blew my mind. How did I not know that? Okay. Well, that's beautiful.

Satchin: Yeah.

Dave: I realized I asked you about your mom, and you started the story but you never told me about the rest of what happened when you put your mom on your lab results. I love this story. Will you share it with listeners?

Satchin: Yeah. What happened was I was telling my mom that she should also try to do this what I called time-restricted eating. My mom is vegetarian, and she lives in India. She does the usual religious fasting. But, you know, when people do religious fasting or any kind of traditional fasting, they're actually drinking fruit juice and a few other nuts and other stuff, and they have no restriction on timing.

And a lot of people in India even though many Indians are vegetarian, they have a very circadian [inaudible 00:25:10] pattern, and in fact, we published a paper last year. We monitored around 100 random people in New Delhi area through a collaborator using very similar approach.

And we found that nearly 50% of adults eat for 16 hours or longer in India. And the reason is, in India people tend to wake up very early, and then they have their first cup of tea, which is usually with milk and sugar and some biscuit, which are essentially highly processed gluten and rice powder or something very bad in terms of glycemic control.

Then, they'll have breakfast around eight or nine. If you ask them, "When do you eat your breakfast?" They will never admit that they had tea or coffee early in the morning. They think tea or coffee doesn't count. And then, the day goes on, they eat. Then, late

at night, some people also have a glass of milk, because it's good to have milk. And people usually have a glass of milk before going to bed.

Similarly, my mom, once in a while she would have a cup of tea, actually, late at night with cream and sugar. And even on her fasting day she would have sometimes this late night tea. And then, she's now 60-plus and she slowly became pre-diabetic, her blood sugar was rising, and she was really concerned because she knew that a lot of her siblings, and also it runs in her family, and she knows how terrible [inaudible 00:26:43] a disease, it's not just popping a pill, there are a lot of different things that come with diabetes.

She tried controlling her diet to different types of food, changed her food habit, but nothing was actually helping. And I was telling her that, no, you've got to stop this late night cream and sugar tea, and then she thought that, that's not the cause of the problem, so we went back and forth and she didn't listen to me.

Then finally, I brought her to the US for six months, and at home I just stopped all kinds of food after six. I said, "No. Kitchen closes at six. We should all stop. No cream, no tea, no coffee, nothing." And initially she felt really bad that, you know, this is her son who brought her to the US, I mean, she comes almost every year, but I was food-depriving my mom after 6 p.m. It sounds really bad, like, you are not feeding your mom after 6 p.m.? Give me a break!

But then, after a month or two, she started feeling great. And in fact, as you [inaudible 00:27:45] well, she has some joint pain and that went down, because we know time-restricting reduces systemic inflammation. When the joint pain went down she also started walking a little bit more.

She used to go to the ... There is a nice park near our house, she used to go there and take two rounds. She started taking three rounds, she started timing herself, and then she improved her pace and she was really feeling great. And then, when she went back to India and checked her blood sugar level her doctor was surprised, because she went from fasting blood sugar up 115 down to 81/82.

Dave: Whoa!

Satchin: She was really excited. She lost a little bit of weight, but she was very excited. She felt light, because of this time-restricted eating, she had lost some fat mass. And now, she has become a complete convert. In fact, she is the one who is telling her siblings, and her friends that they should all adopt this eating pattern.

It's kind of gratifying to see, because a lot of us, we do research and we do very high-impact, basic science research, but very few of us can actually take the finding that we find in mice or rats to real life, and to change human lives. And I'm really thankful for this opportunity that I have at the Salk Institute to do this kind of research, because as I told you, a lot of this research was not funded originally by federal funding.

A lot of it was actually done by philanthropy, by honest taxpayers and philanthropic people who contributed to this research. This is extremely gratifying to see this impact. But at the same time, I must say, we really do not know a lot about what time-restricted eating can or cannot do. We don't know the limitations.

We should not say that this is a cure-all magic pill. We cannot say that this is a silver bullet, unless we clearly understand what are the limitations, and what all it can impact, how long it takes to make that improvement. For example, we know people who start time-restricted eating and can successfully adopt a 10-hour eating window, which is the healthiest one so far, kind of the right balance between going to extreme, to six hours, of eight hours of eating, or too liberal, 12 to 14 hours.

When they do 10 hours, within two to three weeks they will see improvement in sleep. But they may not see improvement in their triglyceride or cholesterol level that quickly. That'll take a few more weeks. Similarly, they might see improvement in [inaudible 00:30:33] maybe after four to five months. And we don't know how long it takes for what type of people.

And then, we know that there are a lot of recent studies that are coming out, showing women who traditionally or habitually eat only within 11 hours, or they have 13 hours overnight fasting have low-risk for breast cancer. And we also know that women who once had breast cancer, and if they eat for 11 hours, fast for 13 hours, they also have very low-risk per recurrence for getting another episode of cancer.

We're also beginning to see that eating time has an interaction with drug. That means, people who are going through cancer chemotherapy or radiation therapy, then there might be an interaction between how many hours they eat or sleep, and what time they're taking the radiation therapy, or the cancer therapy, or the chemotherapy.

There are a lot of, many types of questions at many different levels. At one extreme is very simple thing like how many days does it take to see improvement in sleep? Or, if you don't see improvement in sleep, why? Are there other things, confounding factors? At the other extreme, we have cases like cancer or multiple sclerosis or many ... or IBD or IBS. Can we actually reduce the severity of these diseases? How long it takes? Will it be 10 hours of eating?

And another thing is how does eating the type of food, or the calorie content interacts with the fasting window? Just like you said, if somebody who is eating ketogenic diet, they're already driving that ketone process, and on top of that if they've combined time-restricted eating will it [inaudible 00:32:28] so that they can get away with half the ketone from diet and half the ketone from internal circadian mechanism? There are a lot of different questions.

And if I look at each individual question and ask, can I address those in my lifetime or in the lifetime of my trainees in my lab? The answer is no, we cannot. That's why we have to inspire a lot of scientists all over the world to do control studies. But at the same

time, I'm hoping that through myCircadianClock app, a lot of people will volunteer from all over the world to adopt time-restricted eating.

And since we'll get their other data, for example, what type of calories they're eating? What type of lifestyle they have? At what [inaudible 00:33:18] socio-economic demographic background, then with artificial intelligence and big data mining resources, we can get to these answers much quicker and in cost-effective manner, and we can build those knowledge base very quickly. That's why I'm very excited about this app, myCircadianClock, and it's wide adoption now throughout the world.

Dave: I'm pretty sure that you're going to see a huge influx of people saying, "I had Bulletproof Coffee for breakfast," because they are a lot of listeners on the show, who are the type of people like, "Yeah. I'll give that a try." And they're all already familiar, because I keep talking about it, you know, fasting windows and eating windows, and things like that. I'm hoping for people listening, you should check out the app, because it's really cool, and there's definitely meat on the bone so to speak for this kind of research.

And Satchin, I want to point something out. You're a very unusual type of academic lab researcher, because you're willing to do something that's risky. And what you're willing to do is say, "Here's what we found in the lab. Let's try it." And to compare that, I had a chance to ask Craig Venter a few questions. For listeners, this is the guy, the first human to sequence his own genome, and, you know, one of the big names in sequencing human genomes, and looking at genetic effects of everything.

And I said, "So you have 20 years of data, based on all this data now, can you make any directional recommendations for us, or should we wait until there's more data?", while we had pizza and beer, and he looked at me, he goes, "Let's talk about it over pizza and beer." I'm like, "No."

The difference here is your saying, well, here's what I see in the lab, why don't we try it in humans, because it's probably not harmful. And let's see what happens even if we don't know everything. And the willingness to take action from a research perspective, well, acknowledging that there's a lot more to learn is highly unusual.

Why are you like that? How did you get to be a risk-taking academic in that way? Because it's very unusual and it's very special, and it's the type of thing that changes the world. What made you this way?

Satchin: There are two things. One is I went to another great research institute Sripps Research Institute, which is right next door, actually. And during my PhD, I clearly remember I had a professor Jeff Kelly, who is also a kind of semi-professional [risky inaudible 00:35:47] driver.

And once, he gave me this example. He said, "Well, when you're a [risky inaudible 00:35:53] driver, and you are in the circuit, you're driving. You have to be 95% sure that you can overtake the next car before you hit the gas to its mettle." And the story is very different in science. If you want to be really successful scientist who will leave a lasting

legacy, you have to be 5% sure that you have a chance, before you give it a try. And that kind of stayed with me.

And then, the second thing is when I came to Salk Institute, when I look at say Jonas Salk, this guy who invented the polio vaccine. And he took a huge chance. If you look at polio, we haven't cured polio. But we have prevented it to the extent that we have almost eradicated it. So prevention has a huge, huge power that we haven't [inaudible 00:36:48].

Dave: Right.

Satchin: That's why when I started in circadian rhythm, and what I realized that every [inaudible 00:36:55] cycles, and these eating pattern and all this stuff have huge impact. One limitation that I find is, I can do all the research in mice, but mice don't tell me how they're feeling. Mice can tell me only the things that I measure. They cannot interact with me.

For example, when we started the fast study with myCircadianClock app, we were hoping that people may lose weight, but the chance was pretty slim. They lost weight, we are very excited, but when we asked, "Why did you stick to it for one year?" And when they said that they slept better, that was like that's what this part went on. [inaudible 00:37:39], "Really?" We had no idea that the gut actually talks to the brain. Like, five years ago it never crossed my mind.

Mouse would have never told me that the mouse actually sleep well. But humans told me that. Okay. So they slept well. Then we went back to the lab. And then, we put electrodes on mouse brain, and we asked are the mice sleeping better? And we saw, yes, mice are sleeping better. And then, we went back to fruit flies and we asked, are they sleeping better? And then, what is interesting is, what we found, yes they sleep better, but it's not that they are sleep circuit is improved. What happened was their arousal circuit was modified.

The simple idea is this. If you take a newborn baby who is sleeping with her mom, then the baby kicks 10 times in the night, the mom wakes up every time. The baby doesn't wake up, because the baby has a very high arousal threshold. When we say sleeping like a baby, if we have high arousal threshold, then little things will not disturb us, we'll not wake up.

And what we found is this time-restricted eating raises that arousal threshold. And that came only by doing the human study, because we had no idea that when people do time-restricting, their sleep improves.

It's kind of very fun to go back and forth between humans and testing that idea in animals or in cells, and then figuring out the mechanism, and then getting another insight or another hypothesis, and going back to humans.

For example, we saw a reduction in inflammation in mice, and then when we saw people are saying their joint pain decreased, now we can connect these two. And then we can go back and say, why inflammation is reducing? Now, we are looking at the gut microbiome in animals and then we figured out, "Aha!" That's the key to reducing inflammation.

It's kind of interesting to do the experiments this way, and being in Salk Institute, having awesome people around me who are kind of taking risk every day is also very gratifying, because we got only one life, and if I look at my productive research career, it's only 30 years, and I've already wasted 12 years. I have another 15 to 16 years to do something.

And I always feel also kind of grateful, because what I do in the lab is not my own money, it's not some corporation's money, it's honest taxpayers and philanthropists who are putting their money, they're investing to understand human being, to understand our health. They're investing in our future. And I'm kind of at the interface. I get to do all the cool stuff. I'm like a kid in a candy store, but at the same time I've got to make sure that I pay back all these honest people who have put their faith in my lab. That's another thing that really drives me every day.

Dave: I have two more questions for you.

Satchin: Okay.

Dave: The first one is let's do a quick rundown of stuff listeners can do today based on your research both from lighting and food, so that they can sleep better and have better circadian biology. Just kind of a quick list of bullet points.

Satchin: Okay. One thing is, if they have smart phone, computer screen, all kinds of screens, most computers and smart phones have the night [set inaudible 00:41:23] feature, so they should active that. So that say starting at 8 p.m. onwards, the screen should turn less bright and change color.

Second, if you have some bright lights in your home, think of replacing them or put in a dimmer switch. And also, have a pair of [inaudible 00:41:45] or blue light filtering, true dark, or any kind of glasses. And in fact my new ways of thinking is just use your sunglasses at night-time.

Dave: Yeah. That old song, I Wear My Sunglasses at Night. They were right.

Satchin: And then, try to be outside for at least 10 to 15 minutes every day, because I wear a light-tracking watch on myself, and I was surprised that the only time that I get exposed to bright blue light, or daylight during daytime is when I'm walking from my car to my lab or in the ...

Dave: Wait. A light-tracking watch? What watch is this?

Satchin: This is a research grade watch from Philips, that's only made for, lets say a [inaudible 00:42:34] watch for sleep monitoring and light monitoring.

Dave: All right. I'm talking to you afterwards about how to get one. I'm gonna get one of those.

Satchin: I was surprised that I was getting only 30 minutes outdoor. Now I'm making effort that I get daylight. Then purchase a pair of sleeping mask, eye mask, and ear plugs, that'll help you sleep better. It's a small investment into [inaudible 00:42:59]. And then try to monitor what time you're eating.

And then the best way as I said is you can download any app, but when you download myCircadianClock you have to go to the website and do informed consent, because it's a research study, then you're not only tracking yourself and improving, you're also contributing to research.

But even if you are not doing that, just pay attention to what time you start eating, and then count for 10 hours or 12 hours. If you can do 10 hours that's great, and stop there, because 10 hours of eating, or 11 hours of eating is what we are designed for. Just like our brain needs seven to eight hours of sleep, almost every organ in our body needs 12 to 14 hours of downtime to repair, reset and rejuvenate.

Dave: What about blackout curtains? Making sure your sleeping environment is dark. That's something that really changed things for me. Is that part of your recommendations too?

Satchin: Yes. That's a huge thing. Even if you are wearing an eye mask, it's not comfortable or it will fall off, so that's why a blackout curtain is another big thing. Those are not very expensive. You can go to [inaudible 00:44:10] and you can always find a blackout curtain that fits your budget. Then, carry some electrical tape with you when you're traveling, because ...

Dave: I totally do. We actually make little dots now, the TrueDark, the glasses [inaudible 00:44:26] little dots that fit over LED's in your house, because those little blue LED's, that's enough blue light to matter, right.

Satchin: Oh, yeah. That's a huge amount of blue light. I cannot sleep in the hotel room with all those blue light indicators. That's another thing that I do. And when you're traveling, particularly, transcontinental flight, or long distance travel, I try to get at least 12 to 16 hours of fasting during flight or depending on where you will be, what'll be your next meal, because sometimes you might be in a business trip, where within two hours of landing there is a big dinner or lunch you have to go to. So figure out. Calculate back 12 to 16 hours and then fast during that entire time. It's not worth that airline food, even if you're in business class, believe me.

Dave: Amen. I'm the same way. I fast on flights, and with that and a hat and the TrueDark glasses and noise-canceling headphones, I don't get jet lag.

Satchin: Oh, yeah. Exactly.

Dave: I can fly to Dubai like from California and not have jet lag and it's totally changed my life. But I've gotta control the light spectrum and the food. One or the other isn't enough.

Satchin: No. You got to do both. These are small investment that go a huge way into your health.

Dave: Oh. That's so cool. All right. That's a great list for people listening. This'll be in the show notes, we'll put them in the blog post. And these are very much in alignment with some of the things you've read in the Bulletproof Diet or Head Strong, but this is from a guy whose done the core research at the Salk Institute. This is highly credible information. And it's so credible that he could test it on his own mother, all right.

Okay. My final question for you, Satchin. If someone came to you tomorrow as someone whose changing the world with your research, and said, "Look, I wanna perform better as a human being. What are the three most important pieces of advice you have for me?" And this doesn't have to be from your body of research, but something made you get to where you are and do the things you do, and something makes you wake up every morning. So three most important things that you'd offer to someone who wants to have your level of performance. What would you offer them?

Satchin: One is sleep.

Dave: Okay.

Satchin: You got to sleep until you are satisfied. Some people need eight hours. Some people can do well with five hours. Feel rested.

Secondly, is have some time to yourself. What I mean by that is set aside one or two hours when you can think creatively. You can tackle some new problem. You can think about some new dreams. So how you can get to those things.

And to support these two, you also have to be healthy. That's where you've got to take care of ... You got to kind of think of ... Lifestyle what, when, and how much? We eat, sleep and move on a daily basis. And lifestyle, just like brushing your teeth is something that you do every day. If you think of these nine different things, eat, sleep and move, what, when and how much?, on a daily basis, then you are almost halfway to achieving what you want to do.

Dave: Beautiful pieces of advice. Satchin, give me the URL for your new app one more time, so everyone listening can download that.

Satchin: Yeah. The people have to go to mycircadianclock.org. If they search for "my circadian clock" it will take them to the website, and they can do the informed consent, because it's a research study, and then they'll get the activation code and the link on their email, and they'll start from there.

The app is available in both app store and Google for Android devices and tens of thousands of people from all over the world are using the app. And we also have a support team to answer questions.

Dave: Beautiful. Is there anywhere else people can go to find out more about your research? Do you have a website or any page nthat they could go to if they wanna read more about circadian geekiness?

Satchin: Yeah. Actually, the same website, mycircadianclock.org has a blog post. We try to put blogs. And when they download the app and start using it, every day there are some health tips that relates to circadian rhythm [inaudible 00:48:58] that goes through it. Then, I have my own Twitter handle, SatchinPanda, and I try to put everything new about circadian rhythm, and also once in a while I kind of post something, what I say, milestones in circadian rhythm research or health research.

It's not restricted to circadian rhythm, because as I said, I truly believe lifestyle is what, when, and how much? We eat, sleep, and move. So they'll be about physical fitness, sleep, nutrition quality, quantity, etc. I have a few thousand followers, so I [answer their questions inaudible 00:49:36] once in a while.

Dave: All right. Well, you'll probably get a few thousand more here. There's a surprising number of researchers, medical professionals and pro athletes and people like that who listen to the show. I hope that everyone listening to this, whether you're in one of those fields or not, this is really important stuff that's been missing from the world. I mean, chronic cardio and low-fat diets for long periods of time. All this stuff that made me weigh 300 pounds. I'm a huge fan of your research. And just my personal thanks for both doing the research, but then being willing to talk about it and say, "Well, what if you tried it?" Because we think it might work. And that just takes academic balls. So you've got those, Satchin.

Satchin: Yeah. Thank you.

Dave: Thanks for being on Bulletproof Radio. Totally appreciate your work.

Satchin: Thank you, Dave. I'm glad to be here.